

Air Force Civil Engineer Center

Integrity - Service - Excellence



AFCEC Reorganization/ Shelter Initiatives JOCOTAS Meeting 19 Nov 2013

**Mr. Rod Fisher
AFCEC/CXXM**



AGENDA

- **AFCEC Reorganization**
- **Shelter Initiatives**
 - **BEAR Energy Efficient Shelter System (BEESS)**
 - **Large Shelter energy Efficiency**
 - **BEAR System for Load & Installation Management (BSLIM)**
 - **Smart Shelter Energy Management System**
- **Issues/Summary**



AFCEC Reorganization

- Consolidated Air Force Civil Engineer Support Agency (AFCESA), Air Force Center for Engineering and the Environment (AFCEE), and Air Force Real Property Agency (AFRPA) into one FOA – Air Force Civil Engineer Center (AFCEC)
- HQ at JBSA LACKLAND AFB TX
 - Former AFCESA now AFCEC-East at Tyndall AFB
- Stood up a Requirements & Acquisition Division (CXA) within the Readiness Directorate (CX)
 - Responsible for CE enterprise-wide requirements development, RDT&E, and sourcing acquisition solutions



Shelter Initiatives

- **BEAR Energy Efficient Shelter System (BEESS)**
 - 2008; Began development/testing at Holloman AFB as Solar Integrated Powered Shelter System (SIPSS)
 - 2010; Participated in Net Zero Plus Joint Capability Technology Demonstration (JCTD) at Ft. Irwin, CA
 - 2011; Continued testing at Holloman AFB
 - 2012; Developed joint proposal with Army, funded by Director Operational Energy Plans and Programs (DOEPP) (now ASD OEPP) for Advanced Energy Efficient Shelters
 - 3 year program, over \$17M; 3 phases

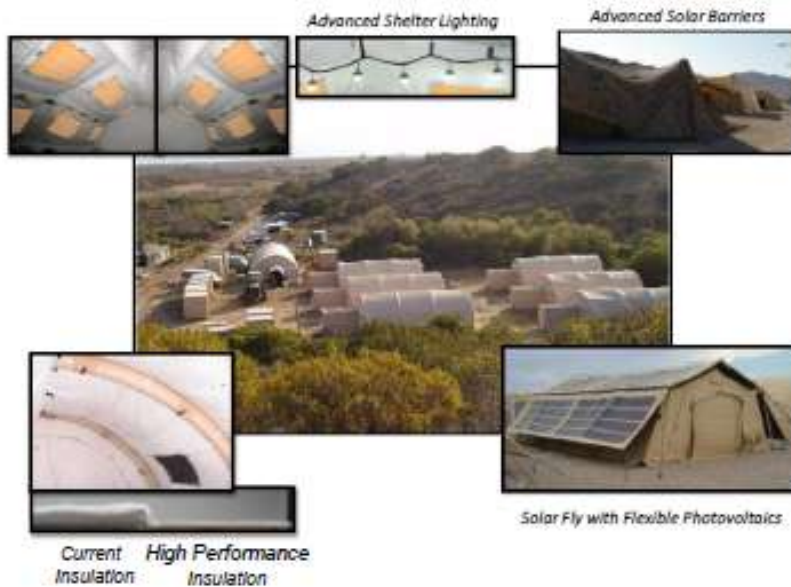


Advanced Energy Efficient Shelters

Natick Soldier Research, Development & Engineering Center

Army Corps of Engineers: Engineer Research & Development Center-Construction Engineering Research Laboratory

Air Force Research Laboratory, Air Force Civil Engineering Support Agency Current



MOTIVATION:

Current shelter systems consist of single layer fabric shells and liners. This results in the requirement for a 5-ton environmental control unit (ECU) to heat/cool each small shelter system, a one-for-one ration. The Field Deployable ECU that is a standard has power demand of over 15kW at ambient temperatures over 115°. This equates to 4.5 mW to cool shelters at an Air Force BEAR expeditionary base (3,300 ppl) or 900 kW at an Army Force Provider camp (600 ppl).

Technology advances in energy efficient shelter technologies have demonstrated reductions in power demand. The Services are now prioritizing Operational Energy and this hopefully will drive dedicated resources to leverage these technology advances. A system-level approach must be taken to integrate these technologies into a final system design that balances the trade-offs between performance, logistical impacts and cost.

PROGRAM PLAN/DESCRIPTION:

- Initial Demonstrations (Jan 2012 – Sep 2013): Test & demonstrate state-of-the-art in an operational environment
- Technology Development (Jan 2012 – Jan 2014)
- Modeling & Simulation: Computational models to optimize thermal performance
- Thermal Barriers: Mature advanced insulation technologies
- Large Shelter Efficiencies: Address the unique energy needs of larger shelter systems
- Follow-On Demonstrations (Jan – Dec 2014): Incorporate lessons learned in Initial Demonstrations and Technology Development to advance the state-of-the-art

MILITARY BENEFIT:

The ultimate products to be transitioned from this effort are energy efficient shelter systems that are optimized combinations of DOD and Industry developed technologies to reduce fuel consumption on the battlefield and manpower requirements for the Warfighter.

- Energy efficient shelter systems that are optimized to reduce fuel consumption on the battlefield and manpower requirements for the Warfighter
- 50% reduction in shelter system power consumption
- 36M gallon per year fuel savings



Advanced Energy Efficient Shelters

■ Current AF Efforts

- Completed joint installation of 15 shelters (8 AF, 7 Army at ASAB, Kuwait)
- Developing/evaluating technologies for medium/large shelters including adjustable insulating liners, coatings, interior/door barriers

■ Future Efforts

- Tear down and ship systems from ASAB to Ellsworth AFB for winter testing Dec 2013
- Incorporate findings from initial evaluations and ongoing research into next generation systems and conduct demonstration/evaluation in 2015



Advanced Energy Efficient Shelters

AF ASAB Technologies

Evaluating technologies, not shelter manufacturers!

■ AF Technologies

- Two shelter types; Standard BEAR SSS, Utilis
- Solar Shade Flys
- Photovoltaic covered flys (4kW and 5kW peak)
- Insulated Liners
- LED Lights
- Energy efficient IECUs
- Thermal coatings, covers for ECUs and ducts
- Insulated vestibules with flys, hard doors



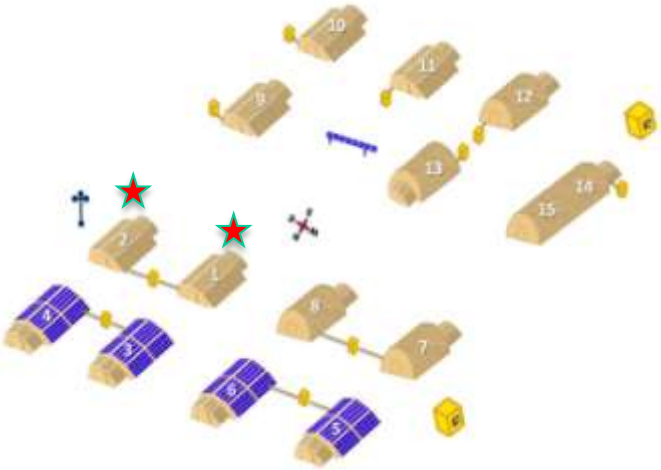
Advanced Energy Efficient Shelters ASAB Deployment



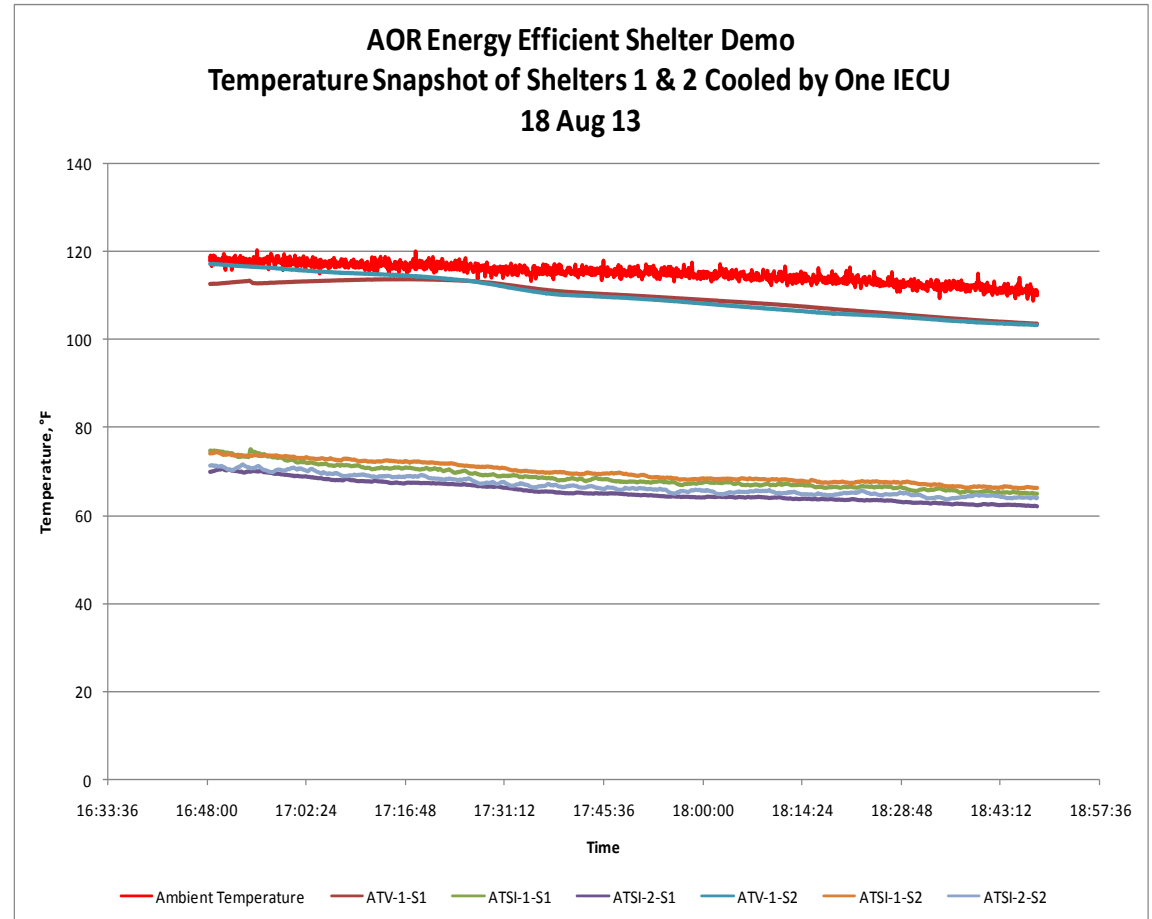
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Advanced Energy Efficient Shelters Snapshot Results



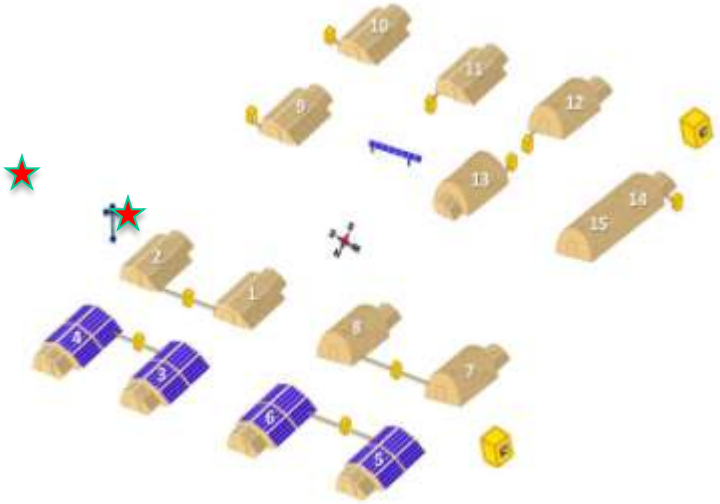
- Two Utilis TM60 shelters with thermal fly, insulated liners
- LED lighting
- Insulated vestibules with hard doors
- Cooled with a single 5-Ton IECU with thermal reduction coating



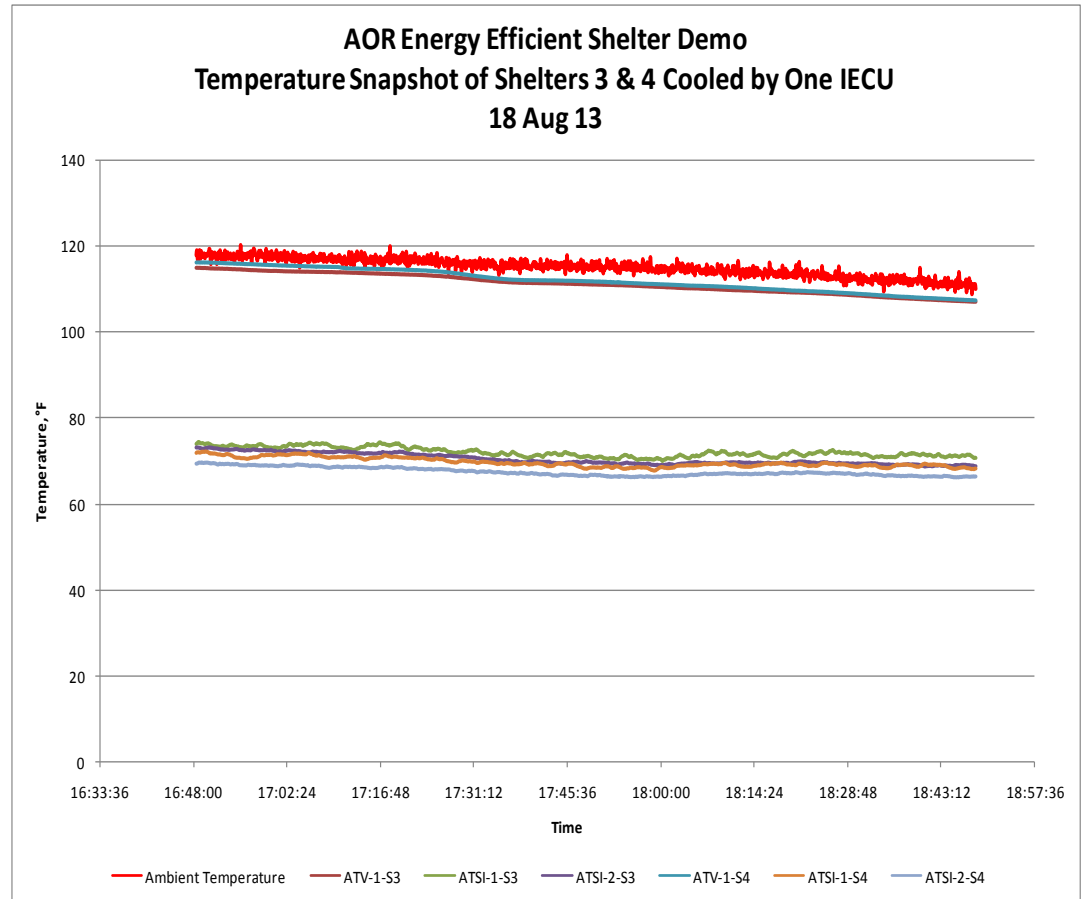
Achieving over 40 degrees of cooling
Power to cool 2 shelters reduced by 2/3



Advanced Energy Efficient Shelters Snapshot Results



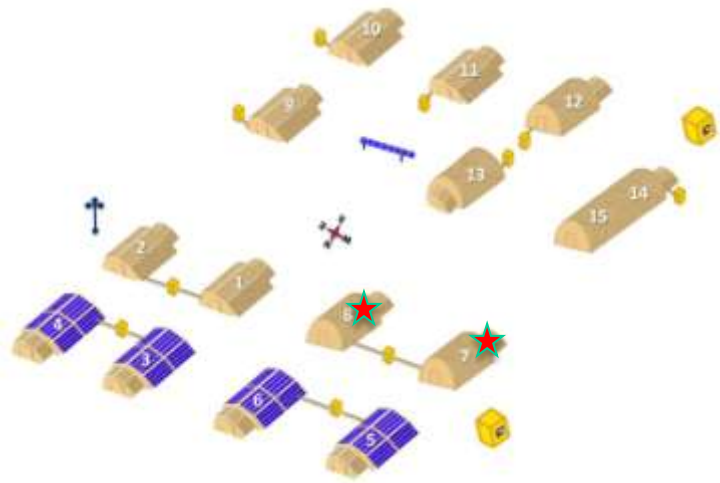
- Two Utilis TM60 shelters with PV shade flies, insulated liners
- LED Lighting (screw-in, string)
- Insulated vestibules with hard doors
- Cooled with a Single 5-Ton IECU with solar covers for ECU, ducts



**Achieving over 40 degrees of cooling
Power to cool 2 shelters reduced by 2/3**

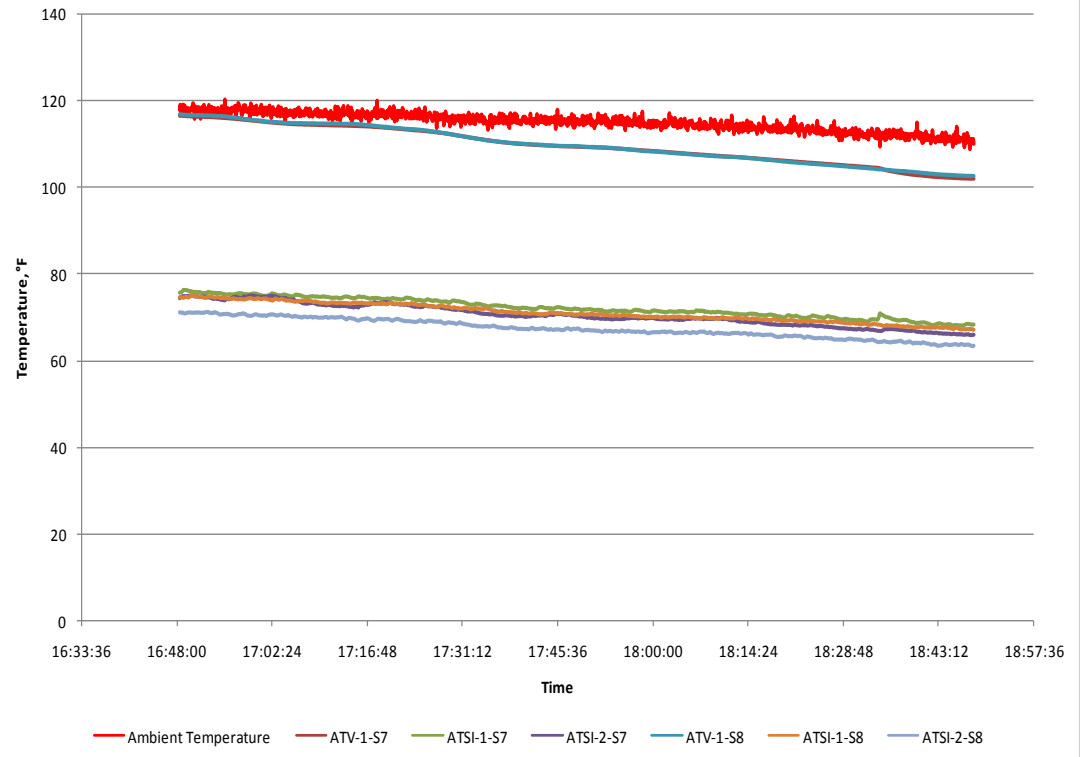


Advanced Energy Efficient Shelters Snapshot Results



- Two AF BEAR Standard Alaska Small Shelter Systems with thermal flys, insulated liners
- LED lights
- Insulated vestibule with hard doors
- Cooled with a single 5-Ton IECU with ECU and ducts painted with a thermal reduction coating

AOR Energy Efficient Shelter Demo
Temperature Snapshot of Shelters 7 & 8 Cooled by One IECU
18 Aug 13



**Achieving over 40 degrees of cooling
Power to cool 2 shelters reduced by 2/3**



Large Shelter Energy Efficiency



Maximize energy security for BEAR assets in the field by considering the energy consumption of medium and larger shelters.

Locate, test and demonstrate technology appropriate to large shelters

Provide Zero Cost Technology Transfer (as appropriate)

- 50% targeted reduction in shelter system power consumption for ECUs

- \$180M/year fuel savings (based on \$15/gal FBCF)



Large Shelter Energy Efficiency Thermal Coatings Evaluation

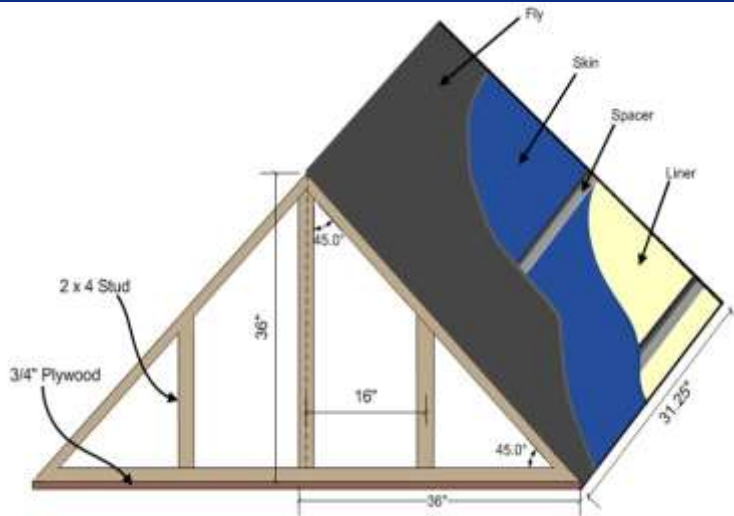


Figure 1



Jigs Description

- Figure 1 shows the dimensions and layers of each jig
- Figure 2 shows a finished sample jig with installed tent skin layer
- Jigs are oriented roughly East-to-West at Tyndall AFB tent city.



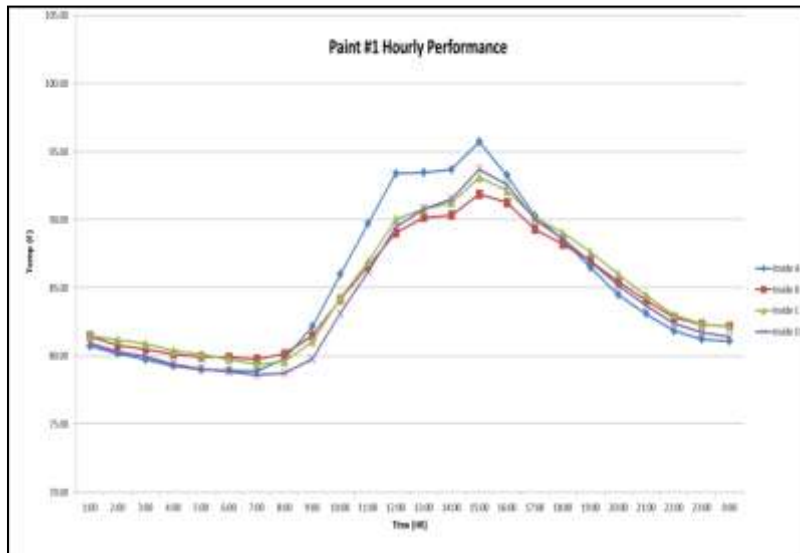
Large Shelter Energy Efficiency Thermal Coatings Evaluation

- A total of fifteen jigs were built to accommodate combinations of layers of tent materials using different thermal coatings
 - Multiple combinations of shelter fabric and flys, baseline and coated.
- Jigs are instrumented to collect surface and air gap temps.
- Data collection Aug/Sept 2013

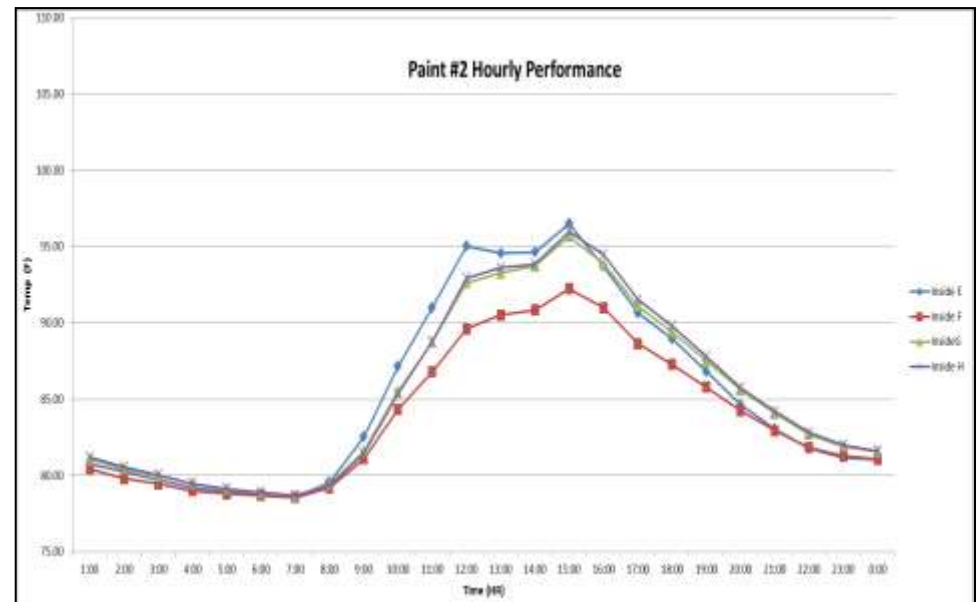


Large Shelter Energy Efficiency Thermal Coatings Evaluation

■ Sample Data from test jigs



Sept 1, 2013





Large Shelter Energy Efficiency Thermal Coatings Evaluation

■ Sample Data from test jigs

Sept 1, 2013

Paint #1---24 hour average				Paint #2---24 hour average				Paint #3---24 hour average				Base Lines---24 hour average		
Inside A	Inside B	Inside C	Inside D	Inside E	Inside F	Inside G	Inside H	Inside I	Inside J	Inside K	Inside L	Inside M	Inside N	Inside O
85.04085	84.53519	84.87982	84.29027	85.38451	83.90122	85.25605	85.39116	84.87763	83.46779	83.68879	83.88335	85.12837	83.54932	83.55523
			↑		↑				↑				↑	
			Lowest		Lowest				Lowest				Lowest	
									Lowest					
Paint #1---Day Time average				Paint #2---Day time average				Paint #3---Day time average				Base Lines---Day time average		
Inside A	Inside B	Inside C	Inside D	Inside E	Inside F	Inside G	Inside H	Inside I	Inside J	Inside K	Inside L	Inside M	Inside N	Inside O
87.88008	86.36794	86.79342	86.34801	88.47366	86.05291	87.86945	88.04123	87.32945	85.05033	85.54355	85.61133	88.08528	85.41728	85.55158
			↑		↑				↑				↑	
			Lowest		Lowest				Lowest				Lowest	
									Lowest					



Large Shelter Energy Efficiency

■ Future Plans

- Divider wall testing in medium shelters
- Transformer Liner tests – instrumented determination of energy saving value of reducing inner liner size/shape
- Jig scale testing of liner variations
- Full-scale instrumented comparison of ULCANS fly with standard medium shelter fly
- Full scale instrumented comparison of “best of show” coatings from jig tests against standard configuration in medium shelter
- Tests of modified entrances, (strip curtains, air curtains, vestibules, etc.)

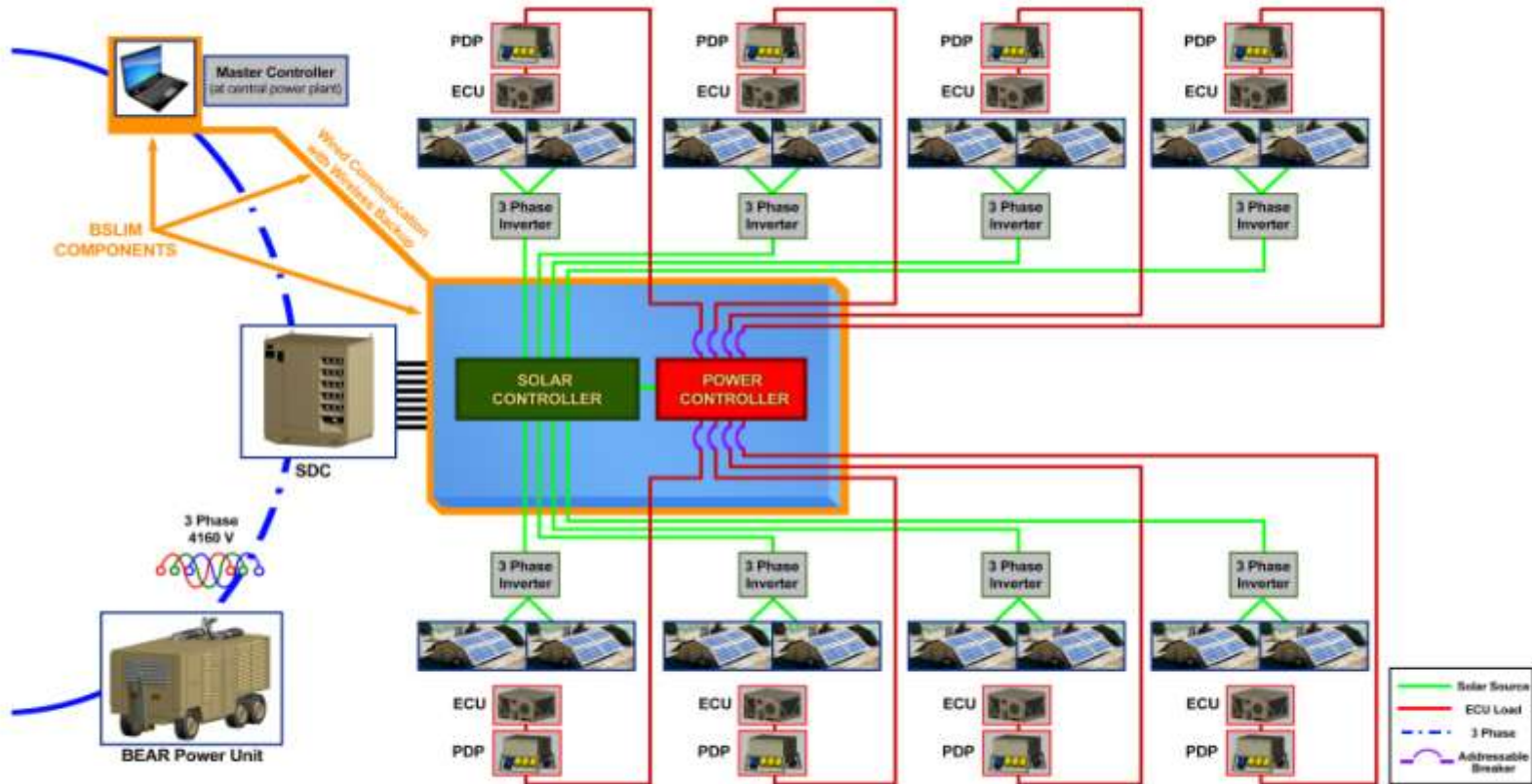


BEAR System for Load & Installation Management (BSLIM)

- **Plug-and-play on the low voltage side of the SDC**
- **Provide capability to:**
 - **Centrally manage loads both pre-programmed and manually via a dashboard view from the BEAR central power plant**
 - **Integrate renewable energy to the BEAR grid**
 - **Power critical loads in the event of a power outage (renewable energy or auto-start back-up generator)**
 - **Modeling of the BEAR grid with distributed renewable energy sources, BSLIM boxes**
- **Fully funded by FY13 CII funds**

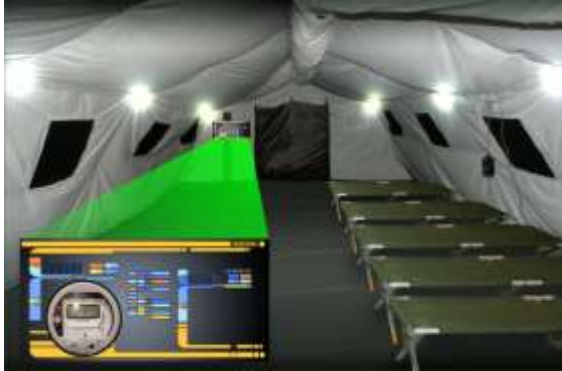


BEAR System for Load & Installation Management (BSLIM) Concept Drawing





Smart Shelter Energy Management System



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Financial Summary – Breakdown of FY12-18 funding down to BPAC

\$M	FY12	FY13	FY14	FY15	FY16	FY17	FY18
PE 0604617F BPAC 652895 CE Readiness	0.0	0.0	\$1.2	0.0	0.0	\$1.2	\$1.2
Total	0.0	0.0	\$1.2	0.0	0.0	\$1.2	\$1.2

- FY14 POM new-start
- Joint initiative with Army based on FY12 proposal ASD-OEPP)
 - Integration and data sharing with BSLIM system
 - Provides shelter occupants information on consumption to foster culture change

Program Description/Objective

Develop autonomous, in-shelter smart control system for expeditionary structures.

AF Energy Alignment

Reduce Demand
Culture Change

25% fuel savings over
current approach

Technologies

- Uses machine vision/artificial intelligence to determine occupancy state of shelter
- Provides integration and data sharing with BSLIM system

Operational Energy Benefits

- 25% reduction of deployed base fuel consumption
- Provides user information on consumption to drive effective culture change

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Issues/Summary

■ Issues

- Joint shelter program impacted by funding delays, contracting delays, and shutdown. About a year behind schedule, will continue into 2015
- FY14 new starts will be impacted by CRA, contracting issues with shutdown of AFRL, standup of AFCEC/CXA
- Availability of modernization acquisition funding to modernize BEAR with new energy systems/capabilities

■ Summary

- AFCEC/CXA is the CE one-stop-shop for both CE-enterprise requirements development and RDT&E execution
- Strong program to develop technologies/systems to significantly reduce BEAR energy demands, respond to the AF Energy Plan with a minimum 50% reduction in energy demand
- Working closely with the joint community through joint programs, JCTDs, and JEBWG



Questions



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